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AMSAT OSCAR 10 Providing Communications Again

The AO-10 IHU was again successfully reset and the transponder is back on at full power according to Peter Guelzow, DB2OS. Peter reports the transponder was successfully reset at 0306 UTC, Saturday, 27 December. AO-10 had been un-resettable in recent days. At this writing (4 Jan.), the transponder was on and delivering excellent communications.

The Mode B transponder has been on continuously and providing excellent communications for satellite users around the world. According to controllers, the sun angle will be improving over the next few weeks and, if the IHU memory holds, the Mode B transponder could remain on indefinitely. The fears that heavy use during poor sun angles could destroy the batteries have diminished somewhat. Controllers are now more optimistic that the satellite can survive even though it is virtually totally beyond their reach in terms of affecting its configuration and orientation.

During recent episodes AMSAT has learned what the spacecraft can endure regarding loading and power drain. The results are encouraging. It would appear that more service can be coaxed from AO-10 despite the fact that the satellite is virtually un-commandable. Consequently, no attitude changes will be possible. The transponder will remain on, apparently, until random noise in the memory causes the transponder control bit to be zeroed. Even then it may be possible to reset it with a master reset. But, as before, major uncertainties arise.

Best advice for now is to get on and enjoy AO-10 while it is providing such good communications. With the latitude of apogee now approaching the Northern Hemisphere, new DX vistas are appearing and it may be a good time to try them out while we can.

In general, while the AO-10 memory condition continues to deteriorate, additional Mode B use may be possible under carefully controlled conditions. QRP use is essential. That means 100 watts ERP or less please. The satellite is currently experiencing eclipses of approximately one hour duration. Use of AO-10 is therefore limited to MA 21 through 199. Please QRT from MA 200 through 020.

[Due to the lag between events and the appearance of ASR *in your mailbox (typically 3 weeks) oft times we get a bit behind with stories. This is regrettable but unavoidable when dealing with the print medium and mail propagation velocity. To keep up with the rapidly changing disposition of AO-10, therefore, we recommend you supplement your* ASR *news with a regular inoculation of updates from your AMSAT nets.]*

TAPR FO-12 Modem Status Report

by Tom Clark, W3IWI

Here's a brief status report on the new TAPR modems for FO-12. We now have made a limited number of 'Alpha' boards for the TAPR modem. I have one working here and there was only one error on the board, so things are converging well. We hope that we will have the next batch ready in a few weeks.

The modem is designed to fit into a small Radio Shack (#270-252A) box. The modem board itself is 3.8'' x 4.8'' in size, with a second board mounting the LED 'bar graph' signal strength and tuning indicators. The modem supports both the FO-12 'Manchester' uplink and direct PSK. It includes digital AFC for controlling modern synthesized all-mode radios. The design includes a bypass switch so that your TNC can work in both its normal (AFSK-FM) mode or in PSK mode. Connections to the TNC are thru a 5-pin DIN connector (the standard TNC-2 interface) and the modem-disconnect header inside the TNC. Your two radios (2m and 70 cm) plug into 5-pin din connectors on the modem. Power consumption is about 60 ma at +12vdc.

The design is functionally identical to that which I showed at the AMSAT meeting in Dallas. Will keep you posted on new developments as they occur.

UoSAT Telemetry Software Available

For several months the AMSAT Software Exchange (ASE) has had orders pending for the UoSAT telemetry capture and decoding software. Unfortunately, these orders have gone unfilled pending an update to the programs to accommodate the subtle changes resulting from the implementation of the DIARY software for UoSAT OSCAR 9 and UoSAT OSCAR 11 early in 1986. Updated versions of the telemetry capture/decode software were at last delivered to the ASE

during the Christmas holidays by Bob Diersing, N5AHD.

The new versions of the programs support both the old format for UoSAT telemetry (used prior to the DIARY software) and the new telemetry format. However, in future releases, only software compatible with the then current UoSAT telemetry format will be supplied.

For those wishing to update older versions of the programs themselves, source listings will be available from the ASE. Replacement disks will not be available and, since the changes to the programs are extensive, users may desire instead to obtain a new version of the program from the ASE rather than engage in the labor-intensive manual update themselves.

AMSAT NA apologizes for the delays in filling the orders for this software but, since our expertise is volunteer and most of our volunteers are thoroughly over-committed, occasionally we must overlook unavoidable delays.

Sidereal Numbers Required For Some Tracking Programs

Some orbital prediction programs, especially the earlier ones, require a revision to the table of sidereal times when going to the new calendar year. If your program is working OK in 1987, chances are you're all set and need do nothing at all. But if your program is spewing out incorrect values for 1987 and you're using one of the older tracking programs, the following values for the sidereal time table may used:

1987 0.27535606
1988 0.27469296
1989 0.27676777

Users should replace prior year tables in the program with values for 1987 on.

Not all programs require updates. Some compute the tables internally and others have tables running for 10 or more years into the future.

Users of the AMS-81 Timex-Sinclair program should send a business-sized SASE to WØRPK for update instructions. His address is: Ralph Wallio, WØRPK RR# 4 Indianola, IA 50125.

Bob Rogers, W8JLE, advises that all versions of the W3IWI program running on the Radio Shack computers, except the Model 4 QUIKTRAK, require updates. The data statements can be found beginning on line 980 or 990 depending on the model.

None of the versions of QUIKTRAK, MAPTRAK, for the C-64 or C-128 computers, or VR-85 or the WØSL programs require updates.

ASR *SPOTLIGHT ON: Phil Karn, KA9Q*

by Pete Killingsworth, KD7WZ

Phil Karn, KA9Q, has served as AMSAT's Assistant Vice President for Engineering since 1982. He states that, "I'm more interested in doing something right than in doing it first." But from his list of projects, it seems he has been doing things right and first for some time.

Most of his projects have been software-related. He provided analysis services to plan the kick motor burn on AO-10 prior to launch and his programs were used to successfully determine the new orbit of AO-10 after firing the kick motor — a "first" for the Amateur Space Program. He wrote the AX.25 protocol in "C" for the Xerox 820 computer. He developed a package of software routines and commands for earth satellite engineering and analysis. He has used these routines for the past several years to generate the Keplerian element sets for AMSAT members and for the AO-10 sun angle and eclipse predictions. So every time we point our antennas into the sky and connect with a satellite, we can thank Phil for keeping the elements updated.

Phil is currently developing an implementation of the ARPA Internet protocols for Amateur packet radio networking. The first release of the software (including source code) is being distributed now. The protocol runs on the IBM PC and the Xerox 820. He is making it available and encouraging hams to use it on as many computers as possible. He has also studied modem design and produced a prototype of a 9600 bps modem for PACSAT. He will be returning to the modem design after his current software projects are completed. Phil keeps busy, out there on the leading edge of Amateur Radio.

Phil is well-qualified for all his technical projects. He holds a BS degree in Electrical Engineering from Cornell University and an MS degree in Computer Engineering from Carnegie-Mellon University. He attended Carnegie-Mellon on a fellowship program from his employer at the time, Bell Labs. His current position is as a Member of the Technical Staff of the packet switching research group at Bell Communications Research.

Phil received his first Amateur Radio license in 1971. He was attracted to the hobby through his interest in electronics which was cultivated at an early age by his father, a non-ham, and his father's hi-fi system. He became interested in satellites on hearing about the OSCAR-6 launch and participating in satellite operations during Field Day with the Baltimore Amateur Radio Club under the tutelage of Marty Davidoff and Art Feller.

Phil's VHF/UHF ham station consists of ICOM IC-271A and IC-471A transceivers connected to an IBM PC for remote or automatic tuning, SSB Electronics preamp, KLM 14C and 18C antennas with Kenpro rotors and a 30- foot tower that his landlord, K2QWG, helped him put up. But you may never talk to Phil on the air. He says, "I do very little on-the-air operation; usually only right after a satellite is launched. Once things get routine, I go back to technical activities like writing software. I do run a packet station on 145.01 MHz connected to a UNIX system. That way I can be on the air without having to be 'on the air'."

Here are some of Phil's views on the various space programs of the spacefaring nations: "I wish they were driven more by meaningful international cooperation instead of nationalistic competition, especially in scientific activities. It ought to be possible to justify a major interplanetary mission, manned or unmanned, by some method other than, 'the Russians will do it first if we don't.' There should also be more emphasis on cost-effective missions with long-lasting potential for scientific, technical and humanitarian benefits and less manned spectaculars for their own sake."

Phil is challenged by the opportunities for technical experimentation and development in Amateur Radio as typified by satellites and packet technology. He also likes being able to infect others with interest in the same subjects. His advice to new hams and satellite users: "Read all you can and learn about all the facets of ham radio before you concentrate on one specialty. Also consider the technical aspects, particularly with a view of contributing something back into the hobby." No one would argue about the value of Phil Karn's contributions to the hobby. He is one of the few with the technical background, the imagination, the energy and the follow-through to help move Amateur Radio forward.

The Problem With Digipeaters

by Tom Clark, W3IWI

I am sitting here in the shack feeling very frustrated. I am watching the activity on 145.01 (although the problem is just as severe on 145.05 or any of the other frequencies in use in the area) watching WA4xxx tying up the frequency for the greater portions of Northern VA, MD, WVA and EPA, trying to connect with a BBS in Pittsburgh using SIX(!) digipeaters. He is having no luck and undoubtedly is wondering why. The basic answer is very simple: *Packet radio doesn't work thru more than 2 or 3 digis!!!*

Oh yes, I hear you saying "You are wrong — the AX.25 protocol permits me to use up to eight digis!". That is a true statement, but just because something is permitted doesn't mean it will work. And here is why —

Assume that you are station ABC at one end of a long string of digi's trying to send out a packet thru digis DEF, GHI, JKL, MNO, PQR, STU and addressed to station XYZ (fake calls are used to protect the guilty!). Thus your intended path is expressed by the following connect command

CONNECT XYZ VIA DEF,GHI,JKL,MNO,PQR,STU

Your outgoing packet then should take the path

ABC = > DEF = > GHI = > JKL = > MNO = > PQR = > STU = > XYZ

At every step along the way, there is a finite chance that the packet is going to be hit by QRM. My observations are that on the very best paths about 5% of packets get clobbered on any single hop. For the example we are using, this means that 95% of the ABC = > DEF packets make it to DEF, and then 95% of them successfully navigate the DEF = > GHI path, and so forth. Thus at the destination XYZ we have

.95 * .95 * .95 * .95 * .95 * .95 * .95 = .70

Only 70% of the data you sent out makes it all the way to XYZ.

But wait — there's more!!!!

AX.25 packet protocols require XYZ to send you back an "ack" (acknowledgement) packet which then has to unwind itself back thru the same route. The same probability arguments apply and 70% of the acks get to you. Thus on a high-quality 95% link thru 6 digis, only .7 * .7 = .49 of your packets are successful thru 6 digipeaters! A Las Vegas gambler could make a very good living on 51/49 guaranteed odds.

But wait — there's more!!!!

We took 95% as the probability of each link working. I know of very few paths that are that good except perhaps at 4 AM when nobody else is on the frequency. Links you tend to think of as "pretty good" probably have 10-20% of your packets trashed on any given hop. And I know of a number of links where the probabilities are no better than 50%. For the general case, if P is the link probability on all links, and N digipeaters are involved, then PA = the aggregate probability of success will be given by the formula

PA = (P) ** (2N+2)

But wait — there's more!!!!

Every time your packet gets clobbered, you try again to push it thru. If 50% of you packets get hit, on average you will try/retry your packet 2 times. In general the number of tries/retries that will be required is

TRIES = 1 / PA

But wait — there's more!!!!

You and everybody else who is on packet spent a lot of money to be able to ragchew and send messages (or data, or nudie pictures, or ???) at 1200 baud. But the packet gurus lied to you. Your data doesn't really flow at 1200 baud — there is some overhead associated with headers that are appended to each and every packet you send, plus some time wasted in getting that all important ack back, plus some time for your radio to change from transmit to receive and back to transmit, plus time waiting for a hole to open up on the channel. At best you can transmit say 600 baud. But for every digipeater you use, another set of similar delays is added at each step along the way. So if you had a perfect set of links thru N digis, your average baud rate would drop to something like

DIGIPEATED BAUD RATE = 600 / (1 + N)

But wait — there's more !!!!

Each time your packet gets clobbered, it is retried, until it gets thru (or until you time out). So the real effective baud rate is slowed even further until it is given by this formula

EFFECTIVE BAUD RATE = 600 * PA / (1 + N)
= 600 * [(P)**(2N+2)] / (1 + N)

But wait — there's more!!!!

Every time you take over the channel with an unsuccessful packet, somewhere along the chain you have prevented some other hapless individual from using that time slot. YOU HAVE HOGGED THE FREQUENCY!

We might express your channel usage efficiency as the ratio of the baud rate that you actually achieved to the baud rate you would have achieved if you had simply used a piece of wire, i.e.

EFFICIENCY = EFFECTIVE BAUD RATE / 1200

More instructive than seeing this factor as a simple numerical ratio is to express it in dB as what I like to call the "Hog Factor" —

HOG FACTOR = 10 log (EFFECTIVE BAUD RATE / 1200)

This factor even includes the 3 dB "loss" for a perfect AX.25 link due to the overhead we discussed earlier.

But wait — there's more!!!!

So far I have only used a few numbers to introduce the concepts. The following four tables tell the whole story. I have worked out a number of cases for links ranging from perfect (P=1.0) to pretty scuzz-ball (P=0.50) and for 0 thru 8 digipeaters. My experience shows that P=0.95 is a pretty rare case, but outside of "prime-time" hours P=0.90 is fairly typical. In the evenings when everybody is on the channel P=0.80 is not unusual. Paths involving "DX" digipeaters (like K3LZ-1 or WB4APR-6 or WA4FRB-3) degrade to P=0.6 or P=0.7 in the evenings simply because they hear so much stuff. And we always have the user in a poor location, running an HT with a rubber duckie who is lucky to have P=0.5!

My advice to all users is that they not even attempt to use a path for which PA < 0.5 (or on average > 2 tries/retries). I have put those "bad" combinations in parenthesis to highlight them. Unless you have an exceptional path (better than P=0.95), these tables clearly show that using more than one or two digipeaters is an exercise in futility which will make you very unpopular with your peers ('Hog Factor' poorer than -10 dB) and drive you to distraction (with effective baud rates slower than about 100 baud). Have I proven my premise from the start of this tome?

Packet Radio Doesn't Work Thru More Than 2 or 3 Digis !!!

Link Success Probabilities Per Hop

N =	P=1.0	P=.95	P=.90	P=.85	P=.80	P=.70	P=.60	P=.50
No. of Digis	**PA = Aggregate Probability of Success**							
0	1.0	0.90	0.81	0.72	0.64	(0.49)	(0.36)	(0.25)
1	1.0	0.81	0.66	0.52	(0.41)	(0.24)	(0.13)	(0.06)
2	1.0	0.74	0.53	(0.38)	(0.26)	(0.12)	(0.05)	(0.02)
3	1.0	0.66	(0.43)	(0.27)	(0.17)	(0.06)	(0.02)	(0.00)
4	1.0	0.60	(0.35)	(0.20)	(0.11)	(0.03)	(0.01)	(0.00)
5	1.0	0.54	(0.28)	(0.14)	(0.07)	(0.01)	(0.00)	(0.00)
6	1.0	(0.49)	(0.23)	(0.10)	(0.04)	(0.01)	(0.00)	(0.00)
7	1.0	(0.44)	(0.19)	(0.07)	(0.03)	(0.00)	(0.00)	(0.00)
8	1.0	(0.40)	(0.15)	(0.05)	(0.02)	(0.00)	(0.00)	(0.00)
	Average number of Tries/Retries before Success							
0	1.0	1.1	1.2	1.4	1.6	(2.0)	(2.8)	(4)
1	1.0	1.2	1.5	1.9	(2.4)	(4.2)	(7.7)	(16)
2	1.0	1.4	1.9	(2.7)	(3.8)	(8.5)	(21)	(64)
3	1.0	1.5	(2.3)	(3.7)	(6.0)	(17)	(60)	(256)
4	1.0	1.7	(2.9)	(5.1)	(9.3)	(35)	(165)	(1,024)
5	1.0	1.9	(3.5)	(7.0)	(15)	(72)	(459)	(4,096)
6	1.0	(2.1)	(4.4)	(9.7)	(23)	(147)	(1,276)	(16,384)
7	1.0	(2.3)	(5.4)	(13)	(36)	(301)	(3,545)	(65,536)
8	1.0	(2.5)	(6.7)	(19)	(56)	(614)	(9,846)	(262,144)
	Equivalent System Baud Rate							
0	600	542	486	434	384	294	216	150
1	300	244	197	157	123	72	39	19
2	200	147	106	75	52	24	9	3
3	150	100	65	41	25	9	3	1
4	120	72	42	24	13	3	1	0.1
5	100	54	28	14	7	1	0.2	0.02
6	86	42	20	9	4	1	0.1	0.01
7	75	33	14	6	2	0.2	0.02	0.001
8	67	26	10	4	1	0.1	0.007	0.0003
	Channel "Hog Factor" in dB							
0	-3	-3	-4	-4	-5	-6	-7	-9
1	-6	-7	-8	-9	-10	-12	-15	-18
2	-8	-9	-11	-12	-14	-17	-21	-26
3	-9	-11	-13	-15	-17	-21	-27	-33
4	-10	-12	-15	-17	-20	-25	-32	-40
5	-11	-13	-16	-19	-22	-29	-37	-47
6	-11	-15	-18	-21	-25	-33	-43	-54
7	-12	-16	-19	-23	-28	-37	-48	-60
8	-13	-17	-21	-25	-30	-40	-52	-67

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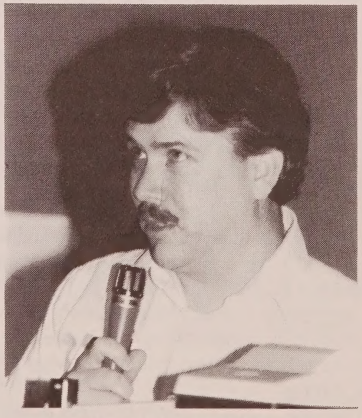

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